CLAIMS

1. An optical communication network system comprising:

a plurality of communication nodes;

a wavelength-routing device which establishes communication between the communication nodes based upon route control according to the wavelength of an optical signal; and

an optical transmission line which forms a communication path which connects the communication nodes and the wavelength-routing device,

wherein the wavelength-routing device comprises:

N device input ports, where N being an integer greater than or equal to 2, which are connected via the optical transmission line to the communication nodes;

N device output ports which are connected via the optical transmission line to the communication nodes;

a plurality of wavelength-band demultiplexers which are provided to each of the N device input ports, and each has a single input port and a plurality of output ports, and the input port is connected to one of the device input ports;

a plurality of wavelength-band multiplexers which are provided to each of the N device output ports, and each has a plurality of input ports and a single output port, and the output port is connected to one of the device output ports; and

R KxK arrayed-waveguide gratings, where R being an integer greater than or equal to J and J being an integer greater than or equal to 2, which have K input ports and K output ports, where K being an integer that satisfies K = N, which have wavelength-routing characteristics in which optical signals having different wavelengths which are inputted to one input port are output at different output ports depending on the

wavelengths of the inputted optical signals and in which optical signals having different wavelengths which are outputted from one output port are optical signals which have been inputted to different input ports, and

wherein the wavelength-band demultiplexers comprise a means which demultiplexes by wavelength band a wavelength division multiplexed signal in which a respective predetermined number of wavelengths have been wavelength division multiplexed for each wavelength band which is transmitted from the communication nodes, where wavelength band = central wavelength λB_m ± wavelength band width $\Delta\lambda_m$, with $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, where $1 = m = R-1$, with m being an integer, and outputs the results at different output ports,

the wavelength-band multiplexers comprise a means which multiplexes optical signals which have been inputted from the plurality of input ports for each wavelength band and which outputs a wavelength division multiplexed signal in which a predetermined number of wavelengths have been wavelength division multiplexed at the output port,

the KxK arrayed-waveguide gratings are provided with a wavelength-routing characteristic for each wavelength band of central wavelength λB_1 ± wavelength band width $\Delta\lambda_1$, central wavelength λB_2 ± wavelength band width $\Delta\lambda_2$ ($\lambda B_1 + \Delta\lambda_1 < \lambda B_2 - \Delta\lambda_2$), central wavelength λB_3 ± wavelength band width $\Delta\lambda_3$ ($\lambda B_2 + \Delta\lambda_2 < \lambda B_3 - \Delta\lambda_3$), ..., central wavelength λB_R ± wavelength band width $\Delta\lambda_R$ ($\lambda B_{R-1} + \Delta\lambda_{R-1} < \lambda B_R - \Delta\lambda_R$),

the output ports of the wavelength-band demultiplexers which are respectively connected to the N device input ports are one to one connected to the input ports of the KxK arrayed-waveguide gratings which have wavelength-routing characteristics at the wavelength bands of the optical signals which are outputted from the output ports of the wavelength-band demultiplexers, and

the output ports of the KxK arrayed-waveguide gratings are one to one connected to the input ports of any one of the plurality of wavelength-band multiplexers which can multiplex optical signals of wavelengths which belong to the wavelength bands of the optical signals which are outputted from the output ports of the KxK arrayed-waveguide gratings.

2. An optical communication network system as described in Claim 1, wherein each of the communication nodes comprises:

a Jx1 wavelength-band multiplexer, where J being an integer greater than or equal to 2, which has J input ports IP [1], IP [2], IP [3], ... IP [J] and a single output port, and output at the single output port optical signals of wavelengths which belong to the wavelength bands of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$, central wavelength $\lambda B_3 \pm$ wavelength band width $\Delta\lambda_3$, ..., central wavelength $\lambda B_J \pm$ wavelength band width $\Delta\lambda_J$, which are inputted to the respective J input ports, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, for $1 = m = J - 1$, where m being an integer;

a plurality of wavelength division multiplexers which are provided at each of the input ports IP [1], IP [2], IP [3], ... IP [J] of the Jx1 wavelength-band multiplexer, and which have two or more input ports and one output port, with the output ports being connected to the input ports of the Jx1 wavelength-band multiplexer; and

a plurality of optical transmitters which are connected to the input ports of the wavelength division multiplexers, and which emit light of wavelengths which belong to wavelength bands of central wavelengths, $\lambda B_m \pm$ wavelength band width $\Delta\lambda m$, and

wherein the output port of the Jx1 wavelength-band multiplexer is connected via an optical waveguide to the device input ports of the wavelength-routing device.

3. An optical communication network system as described in Claim 1 or Claim 2, wherein each of the communication nodes comprises:

a 1xJ wavelength-band demultiplexer, where J being an integer greater than or equal to 2, which has J output ports OP[1], OP[2], OP[3], ... OP[J] and a single input port, and which outputs at the J output ports optical signals of wavelengths which belong to the wavelength band widths which are inputted to the single input port of central wavelength λB_1 ± wavelength band width $\Delta\lambda_1$, central wavelength λB_2 ± wavelength band width $\Delta\lambda_2$, central wavelength λB_3 ± wavelength band width $\Delta\lambda_3$, ..., central wavelength λB_J ± wavelength band width $\Delta\lambda_J$, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, where m being an integer;

a plurality of wavelength division demultiplexers which are provided to each of the output ports OP[1], OP[2], OP[3], ... OP[J] of the 1xJ wavelength-band demultiplexer, each of which has two or more output ports and a single input port, and the input port is connected to one of the output ports of the 1xJ wavelength-band demultiplexer; and

a plurality of optical receivers which are connected to the output ports of the wavelength division demultiplexers, and

wherein the single input port of the 1xJ wavelength-band demultiplexer is connected via an optical waveguide to one of the device output ports of the wavelength-routing device.

4. An optical communication network system as described in Claim 1, wherein each of the communication nodes comprises:

a Jx1 wavelength-band multiplexer, where J being an integer greater than or

equal to 2, which has J input ports IP [1], IP [2], IP [3], ... IP [J] and a single output port, and outputs at the single output port optical signals of wavelengths which belong to the wavelength bands of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$, central wavelength $\lambda B_3 \pm$ wavelength band width $\Delta\lambda_3$, ..., central wavelength $\lambda B_J \pm$ wavelength band width $\Delta\lambda_J$, which are inputted to each of the J input ports, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, for $1 = m = J - 1$, where m being an integer;

at least one wavelength-tunable optical light source integrated optical transmitter which is connected to any one of the input ports IP [1], IP [2], IP [3], ... IP [J] of the Jx1 wavelength-band multiplexer, which is provided with a wavelength-tunable optical light source which can be set to a wavelength within a wavelength band which belongs to the input port which is connected, and which outputs light of the wavelength;

a plurality of wavelength division multiplexers which are provided to each of the input ports of the Jx1 wavelength-band multiplexer, other than the input port to which the wavelength-tunable optical light source integrated optical transmitter is connected, and which have two or more input ports and one output port, with the output port being connected to one of the input ports of the Jx1 wavelength-band multiplexer;

a plurality of optical transmitters which are connected to the input ports of the wavelength division multiplexer, and which emit light of wavelength which belongs to a wavelength band of central wavelength $\lambda Bm \pm$ wavelength band width $\Delta\lambda m$;

a 1xJ wavelength-band demultiplexer, where J being an integer greater than or equal to 2, which has J output ports OP[1], OP[2], OP[3], ... OP[J] and a single input port, and the outputs at the J output ports optical signals of wavelengths which belong to the wavelength band widths of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$, central wavelength $\lambda B_3 \pm$

wavelength band width $\Delta\lambda_3$, ..., central wavelength λB_J ± wavelength band width $\Delta\lambda_J$, which are inputted to the single input port, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, for 1 = m = J, where m being an integer;

an optical receiver which is connected to that output port, among the output ports OP[1], OP[2], OP[3], ... OP[J] of the 1xJ wavelength-band demultiplexer, which belongs to the wavelength band to which the wavelength-tunable optical light source integrated optical transmitter is provided, and which receives an optical signal of the wavelength which is outputted from the wavelength-tunable optical light source integrated optical transmitter;

a plurality of wavelength division demultiplexers which are provided to each of the output ports of the 1xJ wavelength-band demultiplexer, except for the output port to which the optical receiver is connected, which have two or more output ports and a single input port, and the input port is connected to one of the output ports of the 1xJ wavelength-band demultiplexer; and

a plurality of optical receivers which are connected to the output ports of the wavelength division demultiplexers, and

wherein the single input port of the 1xJ wavelength-band demultiplexer is connected via an optical waveguide to one of the device output ports of the wavelength-routing device.

5. An optical communication network system as described in Claim 4, further comprising an optical path management means which controls an optical path between two different communication nodes, and

wherein if at least one group of the wavelength-tunable optical light source integrated optical transmitters exists which are provided to all the communication nodes

and which output optical signals of the same wavelength band, and if there are K wavelength bands, where K being an integer greater than or equal to 2, which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitters, the optical path management means assigns mutually different priority rankings from 1 to K to the wavelength bands which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitters, and when, among the wavelength bands which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitters, the highest numbered priority ranking among the wavelength bands for which optical paths exist between x-th communication node and y-th communication node is number b, and the lowest numbered priority ranking among the wavelength bands for which an optical path whose start point is the x-th communication node, an optical path whose end point is the x-th communication node, an optical path whose start point is the y-th communication node, and an optical path whose end point is the y-th communication node do not exist is number a, and the number a is smaller than the number b, the optical path management means establishes an optical path between the x-th communication node and the y-th communication node upon the wavelength band of a-th priority ranking, and thereafter controls ON/OFF and an oscillation wavelength of the wavelength-tunable optical light source integrated optical transmitter so as to cancel the optical path which was established between the x-th communication node and the y-th communication node upon the wavelength band of b-th priority ranking.

6. An optical communication network system as described in Claim 5, further

comprising:

a database which records an optical path for each wavelength band;

a first search means which, when a requirement has arisen newly to establish an optical path between xx-th communication node and yy-th communication node, searches in the database, in order from data which correspond to a wavelength band whose priority ranking is the lowest, for a wavelength band which is not in use by the xx-th communication node and the yy-th communication node;

a first transmission means which transmits to the optical path management means a command for establishing an optical path according to the result of searching by the first search means;

a second search means which, when a requirement for an optical path which is already established between xxx-th communication node and yyy-th communication node has ceased, searches in the database, in order from data which correspond to a wavelength band whose priority ranking is the highest, for a wavelength band upon which an optical path is established between the xxx-th communication node and the yyy-th communication node;

a second transmission means which transmits to the optical path management means a command for canceling an optical path according to the result of searching by the second search means;

an extraction means which searches in the database the number b of the highest priority ranking among the wavelength bands upon which optical paths are established between the x-th communication node and the y-th communication node, and the number *a* of the lowest priority ranking among the wavelength bands upon which an optical path whose start point is the x-th communication node, an optical path whose end point is the x-th communication node, an optical path whose start point is the y-th communication

node, and an optical path whose end point is the y-th communication node do not exist, for all the combinations of x and y in a predetermined order, and extracts combinations of x, y, a, and b for which the number a is smaller than the number b;

a third transmission means which, when an applicable combination exists, transmits to the optical path management means a command for establishing an optical path using the a-th wavelength band between the x-th communication node and the y-th communication node, and thereafter transmits to the optical path management means a command for canceling an optical path using the b-th wavelength band between the x-th communication node and the y-th communication node; and

a database update means which registers an optical path which has been newly established in the database, and deletes an optical path which has been cancelled from the database.

7. An optical communication network system as described in Claim 1, wherein the KxK arrayed-waveguide gratings have cyclic-wavelength characteristics.

8. A wavelength-routing device which is provided to an optical communication network system comprising a plurality of communication nodes and an optical transmission line which forms a communication path, connected with the communication nodes by the optical transmission line, and which establishes communication between the communication nodes based upon route control according to the wavelength of an optical signal, the wavelength-routing device comprising:

N device input ports, where N being an integer greater than or equal to 2, which are connected via the optical transmission line to the communication nodes;

N device output ports which are connected via the optical transmission line to

the communication nodes;

a plurality of wavelength-band demultiplexers which are provided to each of the N device input ports, and each has a single input port and a plurality of output ports, and the input port is connected to one of the device input ports;

a plurality of wavelength-band multiplexers which are provided to each of the N device output ports, and each has a plurality of input ports and a single output port, and the output port is connected to one of the device output ports; and

R KxK arrayed-waveguide gratings, where R being an integer greater than or equal to J and J being an integer greater than or equal to 2, which have K input ports and K output ports, where K being an integer that satisfies K = N, which have wavelength-routing characteristics in which optical signals having different wavelengths which are inputted to one input port are output at different output ports depending on the wavelengths of the inputted optical signals and in which optical signals having different wavelengths which are outputted from one output port are optical signals which have been inputted to different input ports, and

wherein the wavelength-band demultiplexers comprise a means which demultiplexes by wavelength band a wavelength division multiplexed signal in which a predetermined number of wavelengths have been wavelength division multiplexed for each wavelength band which is transmitted from the communication nodes, where wavelength band = central wavelength $\lambda B_m \pm$ wavelength band width $\Delta\lambda_m$, with $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, where $1 = m = R - 1$, with m being an integer, and outputs the results at different output ports,

the wavelength-band multiplexers comprise a means which multiplexes optical signals which have been inputted from the plurality of input ports for each wavelength band and which outputs a wavelength division multiplexed signal in which a

predetermined number of wavelengths have been wavelength division multiplexed at the output port,

the KxK arrayed-waveguide gratings are provided with a wavelength-routing characteristic for each wavelength band of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$ ($\lambda B_1 + \Delta\lambda_1 < \lambda B_2 - \Delta\lambda_2$), central wavelength $\lambda B_3 \pm$ wavelength band width $\Delta\lambda_3$ ($\lambda B_2 + \Delta\lambda_2 < \lambda B_3 - \Delta\lambda_3$), ..., central wavelength $\lambda B_R \pm$ wavelength band width $\Delta\lambda_R$ ($\lambda B_{R-1} + \Delta\lambda_{R-1} < \lambda B_R - \Delta\lambda_R$),

the output ports of the wavelength-band demultiplexers which are respectively connected to the N device input ports are one to one connected to the input ports of the KxK arrayed-waveguide gratings which have wavelength-routing characteristics at the wavelength bands of the optical signals which are outputted from the output ports of the wavelength-band demultiplexers, and

the output ports of the KxK arrayed-waveguide gratings are one to one connected to the input ports of any one of the plurality of wavelength-band multiplexers which can multiplex optical signals of wavelengths which belong to the wavelength bands of the optical signals which are outputted from the output ports of the KxK arrayed-waveguide gratings.

9. An optical path management device which controls an optical path between two different communication nodes in an optical communication network system which comprises a plurality of communication nodes, a wavelength-routing device which establishes communication between the communication nodes based upon route control according to the wavelength of an optical signal, and an optical transmission line which forms a communication path which connects the communication nodes and the wavelength-routing device wherein the wavelength-routing device comprises:

N device input ports, where N being an integer greater than or equal to 2, which are connected via the optical transmission line to the communication nodes;

N device output ports which are connected via the optical transmission line to the communication nodes;

a plurality of wavelength-band demultiplexers which are provided to each of the N device input ports, and each has a single input port and a plurality of output ports, and the input port is connected to one of the device input ports;

a plurality of wavelength-band multiplexers which are provided to each of the N device output ports, and each has a plurality of input ports and a single output port, and the output port is connected to one of the device output ports; and

R KxK arrayed-waveguide gratings, where R being an integer greater than or equal to J and J being an integer greater than or equal to 2, which have K input ports and K output ports, where K being an integer that satisfies K = N, which have wavelength-routing characteristics in which optical signals having different wavelengths which are inputted to one input port are output at different output ports depending on the wavelengths of the inputted optical signals and in which optical signals having different wavelengths which are outputted from one output port are optical signals which have been inputted to different input ports, and

wherein the wavelength-band demultiplexers comprise a means which demultiplexes by wavelength band a wavelength division multiplexed signal in which a predetermined number of wavelengths have been wavelength division multiplexed for each wavelength band which is transmitted from the communication nodes, wherein wavelength band = central wavelength λB_m ± wavelength band width $\Delta\lambda_m$, with $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, where $1 = m = R - 1$, with m being an integer, and outputs the results at different output ports,

the wavelength-band multiplexers comprise a means which multiplexes optical signals which have been inputted from the plurality of input ports for each wavelength band and which outputs a wavelength division multiplexed signal in which a predetermined number of wavelengths have been wavelength division multiplexed at the output port,

the KxK arrayed-waveguide gratings are provided with a wavelength-routing characteristic for each wavelength band of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$ ($\lambda B_1 + \Delta\lambda_1 < \lambda B_2 - \Delta\lambda_2$), central wavelength $\lambda B_3 \pm$ wavelength band width $\Delta\lambda_3$ ($\lambda B_2 + \Delta\lambda_2 < \lambda B_3 - \Delta\lambda_3$), ..., central wavelength $\lambda B_R \pm$ wavelength band width $\Delta\lambda_R$ ($\lambda B_{R-1} + \Delta\lambda_{R-1} < \lambda B_R - \Delta\lambda_R$),

the output ports of the wavelength-band demultiplexers which are respectively connected to the N device input ports are one to one connected to the input ports of the KxK arrayed-waveguide gratings which have wavelength-routing characteristics at the wavelength bands of the optical signals which are outputted from the output ports of the wavelength-band demultiplexers, and

the output ports of the KxK arrayed-waveguide gratings are one to one connected to the input ports of any one of the plurality of wavelength-band multiplexers which can multiplex optical signals of wavelengths which belong to the wavelength bands of the optical signals which are outputted from the output ports of the KxK arrayed-waveguide gratings, and

each of the communication nodes comprises:

a Jx1 wavelength-band multiplexer, where J being an integer greater than or equal to 2, which has J input ports IP [1], IP [2], IP [3], ... IP [J] and a single output port, and outputs at the single output port optical signals of wavelengths which belong to the wavelength bands of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central

wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$, central wavelength $\lambda B_3 \pm$ wavelength band width $\Delta\lambda_3$, ..., central wavelength $\lambda B_J \pm$ wavelength band width $\Delta\lambda_J$, which are inputted to each of the J input ports, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, for $1 = m = J - 1$, where m being an integer;

at least one wavelength-tunable optical light source integrated optical transmitter which is connected to any one of the input ports IP [1], IP [2], IP [3], ... IP [J] of the Jx1 wavelength-band multiplexer, which is provided with a wavelength-tunable optical light source which can be set to a wavelength within a wavelength band which belongs to the input port which is connected, and which outputs light of the wavelength;

a plurality of wavelength division multiplexers which are provided to each of the input ports of the Jx1 wavelength-band multiplexer, other than the input port to which the wavelength-tunable optical light source integrated optical transmitter is connected, and which have two or more input ports and one output port, with the output port being connected to one of the input ports of the Jx1 wavelength-band multiplexer;

a plurality of optical transmitters which are connected to the input ports of the wavelength division multiplexer, and which emit light of wavelength which belongs to a wavelength band of central wavelength $\lambda Bm \pm$ wavelength band width $\Delta\lambda m$;

a 1xJ wavelength-band demultiplexer, where J being an integer greater than or equal to 2, which has J output ports OP[1], OP[2], OP[3], ... OP[J] and a single input port, and outputs at the J output ports optical signals of wavelengths which belong to the wavelength band widths of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$, central wavelength $\lambda B_3 \pm$ wavelength band width $\Delta\lambda_3$, ..., central wavelength $\lambda B_J \pm$ wavelength band width $\Delta\lambda_J$, which are inputted to the single input port, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, for $1 = m = J$, where m being an integer;

an optical receiver which is connected to that output port, among the output ports OP[1], OP[2], OP[3], ... OP[J] of the 1xJ wavelength-band demultiplexer, which belongs to the wavelength band to which the wavelength-tunable optical light source integrated optical transmitter is provided, and which receives an optical signal of the wavelength which is outputted from the wavelength-tunable optical light source integrated optical transmitter;

a plurality of wavelength division demultiplexers which are provided to each of the output ports of the 1xJ wavelength-band demultiplexer, except for the output port to which the optical receiver is connected, which have two or more output ports and a single input port, and the input port is connected to one of the output ports of the 1xJ wavelength-band demultiplexer; and

a plurality of optical receivers which are connected to the output ports of the wavelength division demultiplexers; and

wherein the single input port of the 1xJ wavelength-band demultiplexer is connected via an optical waveguide to one of the device output ports of the wavelength-routing device, and

wherein the optical path management device comprises:

a means which, if at least one group of the wavelength-tunable optical light source integrated optical transmitters exists which are provided to all the communication nodes and which output optical signals of the same wavelength band, and if there are K wavelength bands, where K being an integer greater than or equal to 2, which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitters, assigns mutually different priority rankings from 1 to K to the wavelength bands which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-

tunable optical light source integrated optical transmitters;

a means which detects that, among the wavelength bands which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitters, the highest numbered priority ranking among the wavelength bands of optical paths between x-th communication node and y-th communication node is number b, and the lowest numbered priority ranking among the wavelength bands which are not used for an optical path whose start point is the x-th communication node, an optical path whose end point is the x-th communication node, an optical path whose start point is the y-th communication node, and an optical path whose end point is the y-th communication node is number *a*, and the number *a* is smaller than the number b; and

a means which, if it has been detected that the number *a* is smaller than the number b, establishes an optical path between the x-th communication node and the y-th communication node upon the wavelength band of a-th priority ranking, and thereafter controls ON/OFF and an oscillation wavelength of the wavelength-tunable optical light source integrated optical transmitter so as to cancel the optical path which was established between the x-th communication node and the y-th communication node upon the wavelength band of b-th priority ranking.

10. An optical path management method which controls an optical path between two different communication nodes in an optical communication network system which comprises a plurality of communication nodes, a wavelength-routing device which establishes communication between the communication nodes based upon route control according to the wavelength of an optical signal, and an optical transmission line which forms a communication path which connects the communication nodes and the

wavelength-routing device, wherein the wavelength-routing device comprises:

N device input ports, where N being an integer greater than or equal to 2, which are connected via the optical transmission line to the communication nodes;

N device output ports which are connected via the optical transmission line to the communication nodes;

a plurality of wavelength-band demultiplexers which are provided to each of the N device input ports, and each has a single input port and a plurality of output ports, and the input port is connected to one of the device input ports;

a plurality of wavelength-band multiplexers which are provided to each of the N device output ports, and each has a plurality of input ports and a single output port, and the output port is connected to one of the device output ports; and

R KxK arrayed-waveguide gratings, where R being an integer greater than or equal to J and J being an integer greater than or equal to 2, which have K input ports and K output ports, where K being an integer that satisfies K = N, which have wavelength-routing characteristics in which optical signals having different wavelengths which are inputted to one input port are output at different output ports depending on the wavelengths of the inputted optical signals and in which optical signals having different wavelengths which are outputted from one output port are optical signals which have been inputted to different input ports,

wherein the wavelength-band demultiplexers comprise a means which demultiplexes by wavelength band a wavelength division multiplexed optical signal in which a predetermined number of wavelengths have been wavelength division multiplexed for each wavelength band which is transmitted from the communication nodes, where wavelength band = central wavelength $\lambda B_m \pm$ wavelength band width $\Delta\lambda_m$, with $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, where $1 = m = R - 1$, with m being an integer, and

outputs the results at different output ports,

the wavelength-band multiplexers comprise a means which multiplexes optical signals which have been inputted from the plurality of input ports for each wavelength band and which outputs a wavelength division multiplexed signal in which a predetermined number of wavelengths have been wavelength division multiplexed at the output port,

the KxK arrayed-waveguide gratings are provided with a wavelength-routing characteristic for each wavelength band of central wavelength $\lambda B_1 \pm$ wavelength band width $\Delta\lambda_1$, central wavelength $\lambda B_2 \pm$ wavelength band width $\Delta\lambda_2$ ($\lambda B_1 + \Delta\lambda_1 < \lambda B_2 - \Delta\lambda_2$), central wavelength $\lambda B_3 \pm$ wavelength band width $\Delta\lambda_3$ ($\lambda B_2 + \Delta\lambda_2 < \lambda B_3 - \Delta\lambda_3$), ..., central wavelength $\lambda B_R \pm$ wavelength band width $\Delta\lambda_R$ ($\lambda B_{R-1} + \Delta\lambda_{R-1} < \lambda B_R - \Delta\lambda_R$),

the output ports of the wavelength-band demultiplexers which are respectively connected to the N device input ports are one to one connected to the input ports of the KxK arrayed-waveguide gratings which have wavelength-routing characteristics at the wavelength bands of the optical signals which are outputted from the output ports of the wavelength-band demultiplexers, and

the output ports of the KxK arrayed-waveguide gratings are one to one connected to the input ports of any one of the plurality of wavelength-band multiplexers which can multiplex optical signals of wavelengths which belong to the wavelength bands of the optical signals which are outputted from the output ports of the KxK arrayed-waveguide gratings, and

each of the communication nodes comprises:

a Jx1 wavelength-band multiplexer, where J being an integer greater than or equal to 2, which has J input ports IP [1], IP [2], IP [3], ... IP [J] and a single output port, and outputs at the single output port optical signals of wavelengths which belong to the

wavelength bands of central wavelength λB_1 ± wavelength band width $\Delta\lambda_1$, central wavelength λB_2 ± wavelength band width $\Delta\lambda_2$, central wavelength λB_3 ± wavelength band width $\Delta\lambda_3$, ..., central wavelength λB_J ± wavelength band width $\Delta\lambda_J$, which are inputted to each of the J input ports, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, for $1 = m = J - 1$, where m being an integer;

at least one wavelength-tunable optical light source integrated optical transmitter which is connected to any one of the input ports IP [1], IP [2], IP [3], ... IP [J] of the Jx1 wavelength-band multiplexer, which is provided with a wavelength-tunable optical light source which can be set to a wavelength within a wavelength band which belongs to the input port which is connected, and which outputs light of the wavelength;

a plurality of wavelength division multiplexers which are provided to each of the input ports of the Jx1 wavelength-band multiplexer, other than the input port to which the wavelength-tunable optical light source integrated optical transmitter is connected, and which have two or more input ports and one output port, with the output port being connected to one of the input ports of the Jx1 wavelength-band multiplexer;

a plurality of optical transmitters which are connected to the input ports of the wavelength division multiplexer, and which emit light of wavelength which belongs to a wavelength band of central wavelength λBm ± wavelength band width $\Delta\lambda m$;

a 1xJ wavelength-band demultiplexer, where J being an integer greater than or equal to 2, which has J output ports OP[1], OP[2], OP[3], ... OP[J] and a single input port, and outputs at the J output ports optical signals of wavelengths which belong to the wavelength band widths of central wavelength λB_1 ± wavelength band width $\Delta\lambda_1$, central wavelength λB_2 ± wavelength band width $\Delta\lambda_2$, central wavelength λB_3 ± wavelength band width $\Delta\lambda_3$, ..., central wavelength λB_J ± wavelength band width $\Delta\lambda_J$, which are inputted to the single input port, where $\lambda B_m + \Delta\lambda_m = \lambda B_{m+1} - \Delta\lambda_{m+1}$, for $1 = m = J$, where

m being an integer;

an optical receiver which is connected to that output port, among the output ports OP[1], OP[2], OP[3], ... OP[J] of the 1xJ wavelength-band demultiplexer, which belongs to the wavelength band to which the wavelength-tunable optical light source integrated optical transmitter is provided, and which receives an optical signal of the wavelength which is outputted from the wavelength-tunable optical light source integrated optical transmitter;

a plurality of wavelength division demultiplexers which are provided to each of the output ports of the 1xJ wavelength-band demultiplexer, except for the output port to which the optical receiver is connected, which have two or more output ports and a single input port, and the input port is connected to one of the output ports of the 1xJ wavelength-band demultiplexer; and

a plurality of optical receivers which are connected to the output ports of the wavelength division demultiplexers, and

wherein the single input port of the 1xJ wavelength-band demultiplexer is connected via an optical waveguide to one of the device output ports of the wavelength-routing device, and

the optical path management method comprises:

a step of, if at least one group of the wavelength-tunable optical light source integrated optical transmitters exists which are provided to all the communication nodes and which output optical signals of the same wavelength band, and if there are K wavelength bands, where K being an integer greater than or equal to 2, which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitters, assigning mutually different priority rankings from 1 to K to the wavelength bands which belong to

the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitters;

a step of, when, among the wavelength bands which belong to the input ports of the Jx1 wavelength-band multiplexer which are connected to the wavelength-tunable optical light source integrated optical transmitter, the highest numbered priority ranking among the wavelength bands for which an optical path exists between x-th communication node and y-th communication node is number b, and the lowest numbered priority ranking among the wavelength bands for which an optical path whose start point is the x-th communication node, an optical path whose end point is the x-th communication node, an optical path whose start point is the y-th communication node, and an optical path whose end point is the y-th communication node do not exist is number a, and the number a is smaller than the number b; and controlling ON/OFF and an oscillation wavelength of the wavelength-tunable optical light source integrated optical transmitter so as to establish an optical path between the x-th communication node and the y-th communication node upon the wavelength band of a-th priority ranking; and

a step of establishing an optical path between the x-th communication node and the y-th communication node upon the wavelength band of the a-th priority ranking, and thereafter controlling ON/OFF and the oscillation wavelength of the wavelength-tunable optical light source integrated optical transmitter so as to cancel the optical path which was established between the x-th communication node and the y-th communication node upon the wavelength band of b-th priority ranking.

11. An optical path management program which causes a computer to execute the steps of the optical path management method as described in Claim 10.

12. A recording medium which can be read by a computer, upon which the optical path management program as described in Claim 11 is recorded.